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THE ECONOMY

AND

SCIENTIFIC MANPOWER RESOURCES

OF THE SOVIET UNION

An Address Delivered by

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During the more than quarter of a century that has passed since the consolidation of Stalin's power position in 1928, the Soviet Union has risen from the status of a relatively underdeveloped country to unquestioned rank as the second largest economy in the world. This growth, even the more remarkable considering the destructive effects of World War II, has been achieved by the transfer of millions of workers from agriculture to urban occupations. At the same time a prodigious effort has been made to educate large numbers of Soviet citizens in modern skills and technology, and an unusually large portion of total national product has been devoted to investment. We estimate that 23 percent of Soviet gross national product goes directly into capital investment--the base for expansion of future military capabilities. Only 15 percent of our own gross national product is used for capital investment purposes. By such means, the USSR has obtained a very rapid expansion in industrial output. As a logical result, the welfare of the population has been treated as a minimum requirement in planning and as a residual in plan execution. Two examples makes this clear:

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First, while capital goods output was rising over tenfold, agricultural production failed to match even the growth of population, indicating a decline in living standards.

Second, plan goals for heavy industry are usually surpassed, while the correspondingly modest goals for consumer goods are chronically underfulfilled.

At the present time the total output (gross national product) of the USSR is more than a third that of the United States and about three-quarters again as large as that of the third largest economy, the United Kingdom. In general, Soviet production of capital goods and basic materials forms a larger proportion of their total output than does equivalent production in the United States. For example, despite a gross national product only one-third as large, Soviet production of coal and of machine tools today is about equal to that of the United States; at the same time, USSR output of automobiles is less than one-eightieth of our own.

My people have read with interest your publication Resources of the World. As applied to the Soviet Union, the problem of food availability appears to be more difficult of solution than the problems of raw material, energy resource, and technical manpower scarcities. Both historical review and current analysis of Soviet economic policy disclose greater determination and success in coping with the latter three problems than in increasing the adequacy and variety of their food supply.

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In their struggle to provide an adequate and varied diet the Soviets have inaugurated their "new lands" program to increase grain supplies. Whether or not this program will in the long run meet with the hoped for success remains a big question. The lack of adequate rainfall makes success doubtful. Soviet land resources are not unlimited as pointed up by Soviet experience this past year in seeding areas to grain that are even now being abandoned to return to grass. The increase in acreage will eventually reach its limit and alone cannot be expected to solve the problem of feeding an ever-increasing population.

If the Soviet ever expect to fulfill their promises of a more varied and high quality diet for their people, they must invest heavily in agriculture and related industries. They must greatly increase the availability of fertilizers and special purpose machinery for tilling and harvesting corn, vegetables and other crops as well as machinery required in developing their animal industry.

Even with a maximum effort of expanding acreage and heavy investment in the means of production, it is probable that the increasing population will overtake availabilities and the Soviets will beforced to increase their imports of quality foods.

The recently announced Sixth Five Year Plan (1956-1960) continues the traditional Soviet policy of emphasizing expansion of heavy industrial output. The accompanying chart shows their industrial production in

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billions of dollars as compared to that of the United States. As can be seen, total Soviet industrial production in 1960 will be nearly two-fifths as great as that of the United States. By contrast, in 1950 Soviet industry was only one-fifth as large as that of the US. To maintain this rapid rate of growth, the USSR must stress labor productivity even more heavily than in the past. The two-thirds increase in investment and the preoccupation with technology indicated in the new Plan underscore the vital role Soviet officialdom has accorded to investment as the chief factor in continued rapid growth. Although Soviet industry and the Soviet economy as a whole may experience a somewhat slower rate of growth in the next five years than in the immediate past, expansion both in the total Soviet output and in the industrial component of total output will substantially exceed the rates forecast for the United States.

Developments in the USSR over the next five years will significantly strengthen the Soviet's war supporting potential. It is expected that the output of the electronics industry, which contributes many essential items required in high performance military equipment (including guided missiles), will be tripled or quadrupled. Also, in the field of special heat resistant alloys where the Soviet have done so much fundamental research, the new five year plan calls for a sixfold increase in production.

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We see no evidence of any weakening in the Soviet leaders' determination to implement the master plan under which their economy is operating. It is the clear intent of the Soviet leaders to overtake and surpass American production and they fully appreciate the role of science and technology in the attainment of this goal. This was clearly stated by Lazar Kaganovich, First Deputy Chairman of the Presidium of the Council of Ministers, who said:

> Only through the wide and rapid introduction of the newest achievements of our own and world-wide science and technology can we reach a level of productivity higher than that of capitalism, which is necessary for the victory of communism.

The persons upon whom the USSR imposes this ambitious objective are men and women who have been highly trained for their scientific-technical task. Since they first entered school they have received training which emphasized science, and they have been offered no electives. Every Soviet high school graduate has received five years of training in physics, five in biology, four in chemistry, ten in mathematics, and a year of astronomy. Compare this program with that of American high school students. Less than ten percent of our high school graduates have taken as much as a year of physics and chemistry, and only three and a half percent take any advanced mathematics such as solid geometry or trigonometry. Recently, Soviet schools have increased the number of practical subjects such as machine operation and practice farming at the expense of the humanities.

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Beyond the high school level, the Soviet student may attend three types of higher educational institutions:

(1) Specialized engineering and technical colleges--about 180 in the physical sciences--which offer four- to five-year courses in such specialized fields as machine building and construction. These schools are sponsored by the various ministries, and they supply engineers and specialists trained for the purposes of the respective ministries.

(2) About 24 polytechnical institutes, which offer four- to six-year courses in broad technical fields.

(3) Thirty-three universities, which offer courses of five to five and a half years emphasizing broad and fundamental knowledge. Most university graduates enter teaching, but the better students in the sciences are funneled into research.

Two advanced degrees may be granted the Soviet student after graduate study: the Kandidat degree, which is roughly comparable to our Ph. D., and the Doktor degree, which is an advanced degree with no counterpart in the United States. In 1954, about 9,400 Soviets received Kandidat degrees, and about 9,000 Americans received Ph. D's.; about 8,100 of the Soviet degrees were awarded in scientific fields, as compared to 5,000 of the U. S. degrees. Thus, about 85 percent of Soviet Kandidat degrees, as compared with about 55 percent of U. S. Ph. D's., are awarded in the natural sciences.

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The USSR now has about two-thirds the number of scientists that the U. S. has in the research and teaching aspects of physical and biological sciences; 175,000 versus 265,000. In research alone, the USSR has about half the U. S. number; 120,000 versus perhaps 210,000.

Soviet colleges receive about 500,000 students and graduate about 250,000 each year. Total U. S. entrants and graduates are about 10 percent higher, but the Soviet train a far greater proportion in the sciences than we do. This is the key to the outlook for the future. In 1955 about 60 percent of graduating full-time Soviet students were in scientific and technical fields compared with about 25 percent in the U. S. In 1955, the Soviet Union graduated from all schools about 80,000 in the physical sciences and engineering and about 50,000 in the life sciences. In the U. S. about 37,000 were graduated in the physical sciences and 35,000 in the biological sciences. At this greater rate of graduation in sciences--now 130,000 annually in the Soviet Union as opposed to 72,000 in the U. S.--the Soviets will attain an imposing advantage in numbers of scientists and engineers in a few years' time if they and we continue at our present rates.

Usefulness to the state is the dominant criteria governing the direction of students into the various curricula. The state thus controls by admission to advanced training the numbers of physicists,

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chemists, and so on. Similarly, upon completion of his education, the fledgling Soviet scientist is offered positions according to state needs. All attempts to favor selection of "proletarians" were abandoned at the end of 1935.

Women comprise a much larger proportion of college graduates in the USSR than in the U. S. In the USSR, women compose about 50 percent of the student body of higher educational institutions, as compared to about 25 to 35 percent in the U. S. In the field of education as much as 70 percent of each country's graduates are women. In health fields a comparably large proportion is occupied by Soviet women, while in engineering and agricultural fields, those in which there are a negligible number of U. S. women, Soviet women constitute a substantial minority. Soviet women professionals are employed largely in industry and teaching--about 35 percent of all teachers in higher educational establishments are women.

For promising students, a state-financed education in science is a likely prospect. As rewards for hard work and success, the aspiring scientists can look forward to high rank expressed in terms of preferential treatment in salary, housing, and perquisites. State prizes worth several thousands of dollars await many kinds of outstanding scientific accomplishments.

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Technicians and skilled labor are also important in the Soviet scientific-technical effort. The Soviets are more apt than we to obtain their foremen and skilled labor from their educational system than from practical experience in industry. Supporting technicians are drawn from the same elementary schools that supply college entrants. Seven-year education is compulsory and nearly universal. Over recent years, only about 10 percent of students entering the first grade have graduated from the tenth grade. Most students, before reaching the tenth grade, have been absorbed into factory and trade schools, which supply skilled labor, and into technicums, which are schools roughly comparable to our technical high schools, conducting three to four years of specialized training. Short-term technicums are now being established to accommodate the demand for skilled technicians from among the increasing numbers of ten-year school graduates who cannot be admitted to universities or colleges.

In 1954 about 1.2 million semi-professsionals were being trained in specialized schools, and an additional 600,000 were enrolled in extension courses. This represents a dramatic effort on the part of the USSR to overcome a deficiency in skilled supporting manpower.

Let us now look at the Soviet scientific research effort which is supported by the scientists and skilled technicians we have been

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talking about. The Soviet scientific research effort is organized along the following three general lines:

(1) Both fundamental and applied research are conducted by the Academy of Sciences, USSR, and the academies of sciences of the constituent Union Republics. Responsible directly to their respective councils of ministers, they have no true counterparts in the West. They account for one-tenth of Soviet scientific manpower and include many of the Soviet Union's top scientists.

(2) Research institutes of industrial and other economic ministries employ about two-fifths of all Soviet scientists and are roughly comparable to government, commercial, and private research establishments and laboratories in the U. S. A notable example is the Central Aerohydrodynamics Institute which does work comparable to the laboratories of our National Advisory Committee for Aeronautics.

(3) Higher educational institutions employ the remaining half of the Soviet scientists as teachers. This segment has recently been criticized for failing to provide its share of useful research in the way that American university scientists do.

Research is not as carefully planned and coordinated as might be expected in a totalitarian economy. There is much parallelism since each ministry plans its own research program. There is the heavy hand of bureaucracy as shown by the comment of the vice president

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of the Soviet Academy of Medical Sciences, "We not only organize badly, but we constantly reorganize." The Academy of Sciences, USSR, is attempting by a community structure to coordinate activities on a project basis.

Furthermore, the Communist Party has great power and is an effective means of insuring coordination in areas of high priority. We can see the effect of party discipline in such program as atomic energy, guided missiles, aircraft, and electronics. For example, the Soviet Five-Year Plan recently announced plans for the construction in the period 1956-1960 of 2,000 to 2,500 megawatts of electrical power generating capacity using nuclear energy. Under present plans, the U. S. will construct approximately 800 megawatts capacity in the same period. Even granting an economic need for this formidable Soviet goal, we can also see its political expediency and the dramatic support it gives to Soviet propaganda lines.

On the other side of the ledger, party interference in genetics during the Lysenko controversy certainly contributed to the Soviets' sizeable agricultural problems. Generally speaking, however, party interference has not presented a major obstacle to progressive research.

Party and government policy assures adequate funds for scientific research. In terms of gross national product, the Soviet research

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expenditure of about one percent is comparable to our own. A direct dollar comparison of the Soviet and U. S. expenditures is not feasible, but there may be less disparity between the research efforts of the two countries than would be indicated by the 1:3 relationship between Soviet and U. S. gross national product.

The most universal means of encouraging efficient utilization of research resources is an effective method for the dissemination of scientific knowledge. The Soviets have a comprehensive system of abstracting the world's scientific literature which puts them in an enviable position to exploit foreign developments. We have examples of published American scientific articles appearing in Soviet abstracting journals before their appearance in the comparable American abstracting journals. Such an effective abstracting service makes a considerable contribution to the direction of the research effort toward promising investigations and to the elimination of duplication.

Soviet research has achieved some notable results. Its achievements vary according to the nature of the research itself and according to the field of probable application. Generally, Soviet scientists are quite good in theory; in the theoretical aspects of physics, for example, the Soviets are on a par with any country in the world, their theoretical metallurgy is outstanding, and some of their research into human nervous system, following the Pavlovian school, is qualitatively

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unique. They may tend to lag a bit in experimental work, but there are enough exceptions here to make such a generalization precarious. Certainly, we have to give full credit to their development of a ten billion volt proton synchrotron, the largest particle accelerator in the world.

Soviet research achievements are incorporated in Soviet technology through a system of priorities. The Soviet economy does not have the capacity to absorb research results in all fields as does ours. Greatest use of research results therefore is made in areas essential to national power and military strength as opposed to the consumption sector of the civil economy. The latter has been little affected by scientific research and development.

In summary, these are the highpoints of this review of the economy and scientific manpower resources of the Soviet Union:

A. During the post war period, the Soviet economy has continued to expand at an unprecedented rate.

B. The Soviet leaders realize that the continued expansion of their economy and thus their war-making potential is dependent on a continually increasing corps of scientists and engineers.

C. Their pool of highly trained scientists and engineers, now approximately equal to that of the U. S., is being increased at a proportionately greater rate than ours--in a few years we may see them attain a decisive advantage in total numbers.

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D. A vigorous program of training of specialized technicians will improve their relative standing in this important category.

E. By the functioning of state control the Soviets are able to direct the stream of trained scientists into proper channels according to need.

F. There is no sparing of funds for scientific research.

G. It is the announced Soviet intention to utilize the best of available foreign scientific knowledge and they have instituted a large-scale system for such exploitation.

H. Scientific achievement is encouraged by a system of awards and special privileges which elevates scientists to the top rung in the communist version of the socio-economic ladder.

I. The USSR makes full use of the contribution which women can make to its scientific effort.

These are statements worth pondering.

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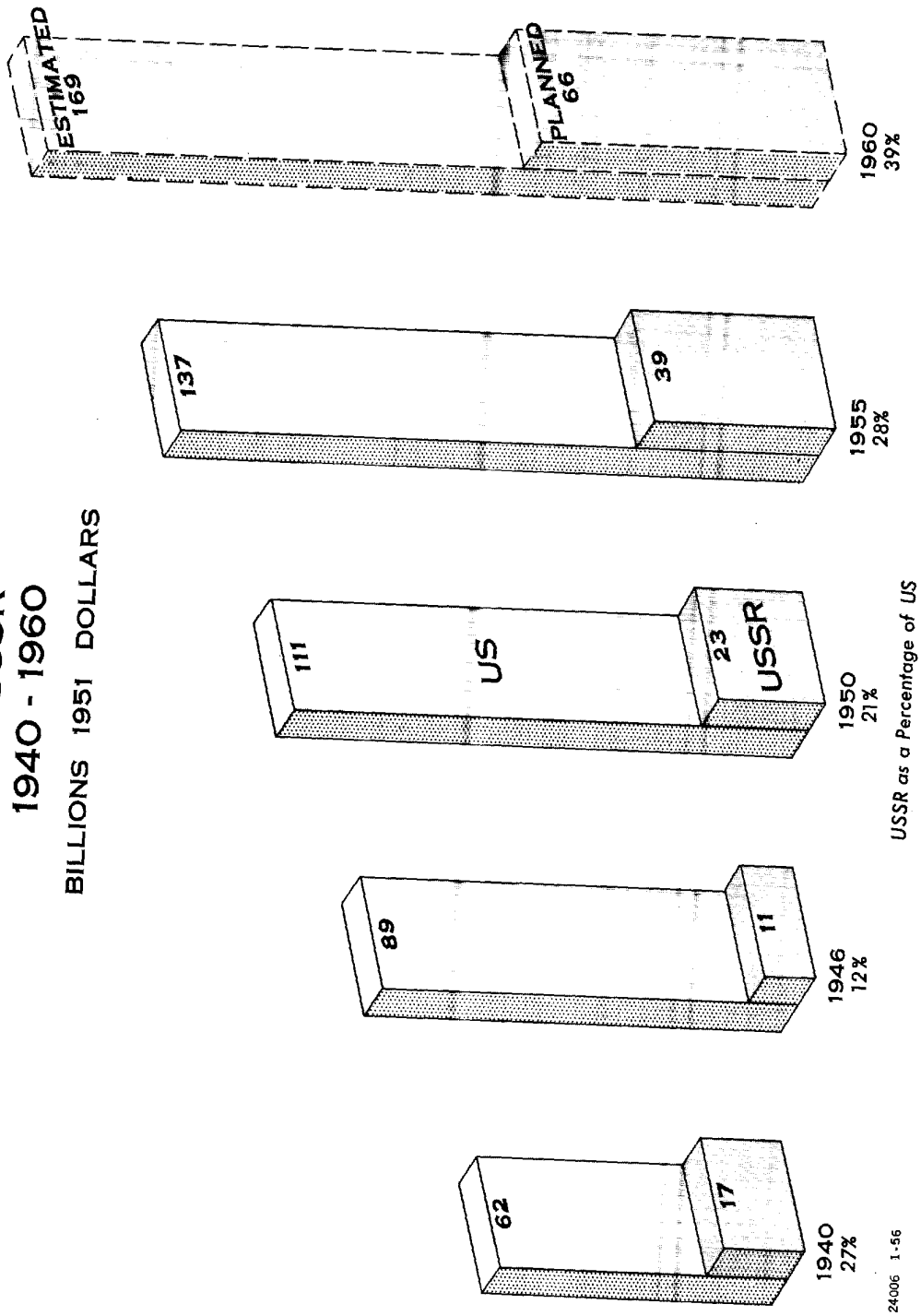
GROWTH OF INDUSTRIAL PRODUCTION

US - USSR
1940 - 1960

BILLIONS 1951 DOLLARS



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